

***Bathysabellaria spinifera* (Polychaeta: Sabellariidae), a new species
from deep water off New Caledonia, southwest Pacific Ocean**

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Abstract.—A new species of the genus *Bathysabellaria* Lechapt & Gruet, 1993, is described from New Caledonia (southwest Pacific Ocean). *Bathysabellaria spinifera*, new species, is known from depths between 570 and 700 m. The only other described species in this genus is the type species, *Bathysabellaria neocaledoniensis* Lechapt & Gruet, 1993, which also occurs off New Caledonia at more shallow depths; between 440 to 450 m. *Bathysabellaria spinifera* differs from the type species in having two forms of opercular paleae in the inner row instead of a single kind. The presence of a ventral median organ near the anterior end of the prostomium is described. This feature has not been previously noted in species of Sabellariidae. A table of the primary diagnostic characters that distinguish *Bathysabellaria* from other known genera in the subfamily Lygdaminae Kirtley, 1994, is included.

The genus *Bathysabellaria* Lechapt & Gruet, 1993, was erected to include distinctive and previously unrecognized forms of Sabellariidae from localities off New Caledonia. Although species of other genera in the family have been described by various authors from the general region of the southwest Pacific Ocean area (see *Remarks*, below), Lechapt & Gruet's account was the first report of Sabellariidae from the immediate vicinity of New Caledonia.

Examples of the new species described in this paper were received from the Centre National de Tri d'Océanographie Biologique, Brest, France. They were collected during a bathyl and abyssal benthos survey designated "Biologie de Nouvelle Calédonie" (BIOCAL) during a cruise of the N/O *Jean Charcot* in August, 1985. The cruise was part of a cooperative effort, "Programme Interdisciplinaire de Recherche Océanographique," sponsored jointly by the Centre National de Recherche Scientifique (CNRS) and the Muséum National

d'Histoire Naturelle, Paris (MNHNP) under the direction by C. Levi. A total of 446 samples of this species were recovered from four stations with Waren type rock dredge. At the time of collection the animals were fixed in formalin and sea water solution and later stored in 60% ethanol.

The external morphology of the worms and of diagnostic hard parts, excised and mounted on glass slides, were examined using binocular light microscopes. An individual specimen was mounted on a brass Scanning Electron Microscope (SEM) stub, dehydrated in acetone; dried using critical-point drying procedures, sputter-coated with a thin layer of gold-palladium, and examined and photographed in a SEM. Some excised chaetae were also mounted on SEM stubs and prepared for study using the same procedure.

The holotype (MNHNP UC341) and some paratypes (MNHNP UC 342) have been deposited in the Museum National d'Histoire Naturelle, Paris. Other specimens

have been deposited in the Allan Hancock Foundation Polychaete Collection of the Los Angeles County Museum of Natural History (LACM-AHF POLY 1689), the Smithsonian Institution, National Museum of Natural History, Washington, D. C. (USNM 172587-172588); and the Harbor Branch Oceanographic Institution Museum (HBOM 050-2584). The remaining specimens are retained in the authors' personal collections. The uncatalogued SEM stubs are available on loan from (JPL) from the MNHN, Laboratoire Maritime, Dinard, France.

Family Sabellariidae

Subfamily Lygdaminae Kirtley, 1994

Genus *Bathysabellaria* Lechapt & Gruet, 1993

Bathysabellaria spinifera, new species

Figs. 1-8

Material examined.—Southwest Pacific Ocean, BIOCAL stations off New Caledonia; N/O *Jean Charcot*; Waren rock dredge; Coll. C. Levi; Holotype (MNHNP UC 341): Station DW 46; 22°53'S, 167°17'E; depth 570-610 m; 30 Aug 1985, (type locality). Paratypes: 144 specimens (MNHNP UC 342). Station DW 51, 23°05'S; 167°45'E, 680-780 m, 30 Aug 1985. (287 specimens). Station DW 36 23°08'S; 167°11'E, 659-680 m, 29 Aug 1985, (11 specimens). Station DW 33, 23°10'S; 167°10'E, 675-680 m, 29 Aug 1985, (3 specimens).

Description.—Body length of holotype 12 mm excluding the cauda, distal portion of which is missing; width of opercular crown 1.8 mm. Prostomium cryptocephalic (Figs. 1a, 2a; 6B; and see *Remarks*, below). With ventral unpaired median organ near anterior midline of prostomium (Figs. 1a, 2a, b). Anterior ends of opercular lobes and crown completely fused along anterior midline; without midventral declivity (Figs. 1a, b; 2a, b; 6B). With numerous small eye spots in longitudinal series on both sides of posterior end of midline of prostomium (Fig. 2a). Eye spots partially obscured by tiny blotches of

dark dermal pigment (Fig. 2a). Anterior margin of opercular lobe completely encircled with 18-20 small conical papillae (=“opercular papillae” of Orrhage, 1978: 345, and fig. 1c; “cirri” of several authors; “fleshy papulae” of Smith, 1981:24, fig. 2A; “subulate palpi” of Lechapt & Gruet (1993: 244); “pericoronal palpi” of Kirtley (1994: 185, fig. 11.1.1 c, d)) (Figs. 1a, b; 2a, b; 6B). The two papillae adjacent to the ventral midline appear to be different from the others in the series (see *Remarks*, below). Opercular paleae in two concentric rows. Outer paleae 20 on each side, forming two complete half-rings on periphery of crown; with bright yellow, wide, thick, translucent blades. Inner surface of blades slightly concave; with transverse thecal bands (sensu Kirtley, 1994: 5); bands more closely spaced toward distal ends (Fig. 3a) than through proximal portion of blade (Figs. 3a; 4B; 5C), thecae with irregularly pectinate (frayed) distal margins (Fig. 5C); trace of thecae roughly horizontal through middle part and base of blade (Fig. 3a). Blades with smoothly tapering, mucronate, distal ends; some tips frayed and abraded (Figs. 4B, C). Outer paleae are all of similar size and shape with lateral margins of blades overlapping edges of adjacent blades (Figs. 3a; 6B). The basal (proximal) parts of the blades are slightly widened and rotated at small angles to the vertical axis of the shafts (Figs. 3a; 4B, C), producing a left- and right-hand (mirror image) symmetry according to which of the two sides of the crown that they occur. Paleal shafts almost cylindrical, slightly thicker at distal end than at proximal end. Inner paleae consist of 15 long and 20 short forms. Long forms with erect spiniform blades; distal ends of blades curving inward toward center of operculum, terminating in smooth points (Figs. 1a, b; 2b; 3b; 4A, 5A, B). Short forms with stout transversely constricted blades; distal ends with obliquely truncated inner surfaces with medial, slightly convex, longitudinal ridge; distal ends terminating abruptly as blunt tips (Figs. 3a; 5b); shafts of inner paleae more slender than those in long forms; both forms

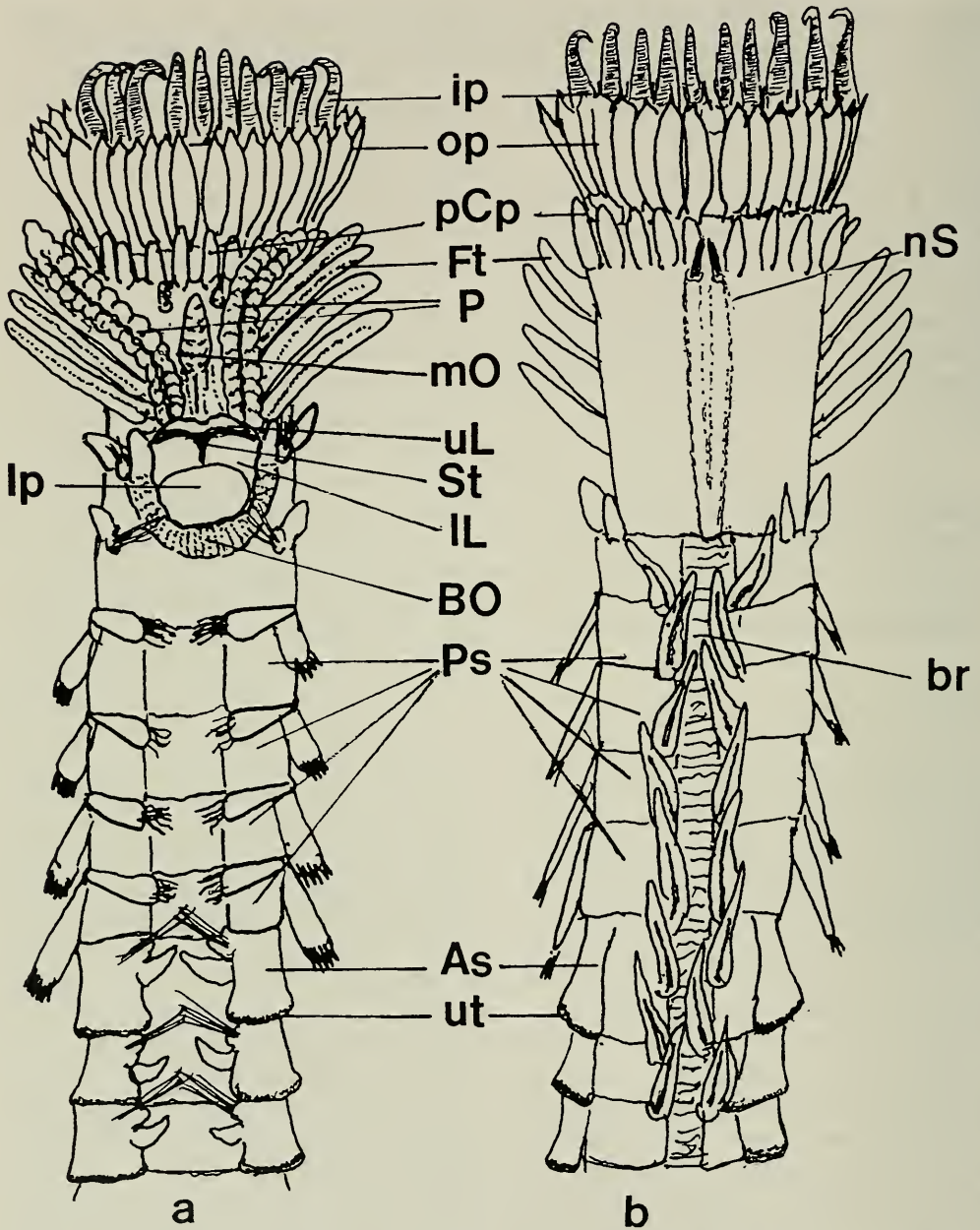


Fig. 1. *Bathysabellaria spinifera*, new species, paratype. (a) anterior end, ventral view. (b) anterior end, dorsal view. ip, inner paleae; op, outer paleae; pCp, pericoronal papulae; Ft, feeding tentacles; P, palpi; mo, median organ; ul, upper lip; St, stomia; IL, lower lip; lp, labial pouch; BO, building organ; ps, parathoracic segments; As, abdominal segments; ut, uncinigerous tori; nS, nuchal spine; br, branchia. Scale bar = 1.5 mm.

with transverse thecal bands with frayed distal fringes (Figs. 2b, c; 5B); thecae in middle portion of blades more widely spaced than those near proximal and distal ends. The ir-

regular crowding of the middle paleae apparent in Fig. 5A is thought to result from post-mortem shriveling of soft tissue. Paired, yellow-gold, fusiform, distally attenuate and

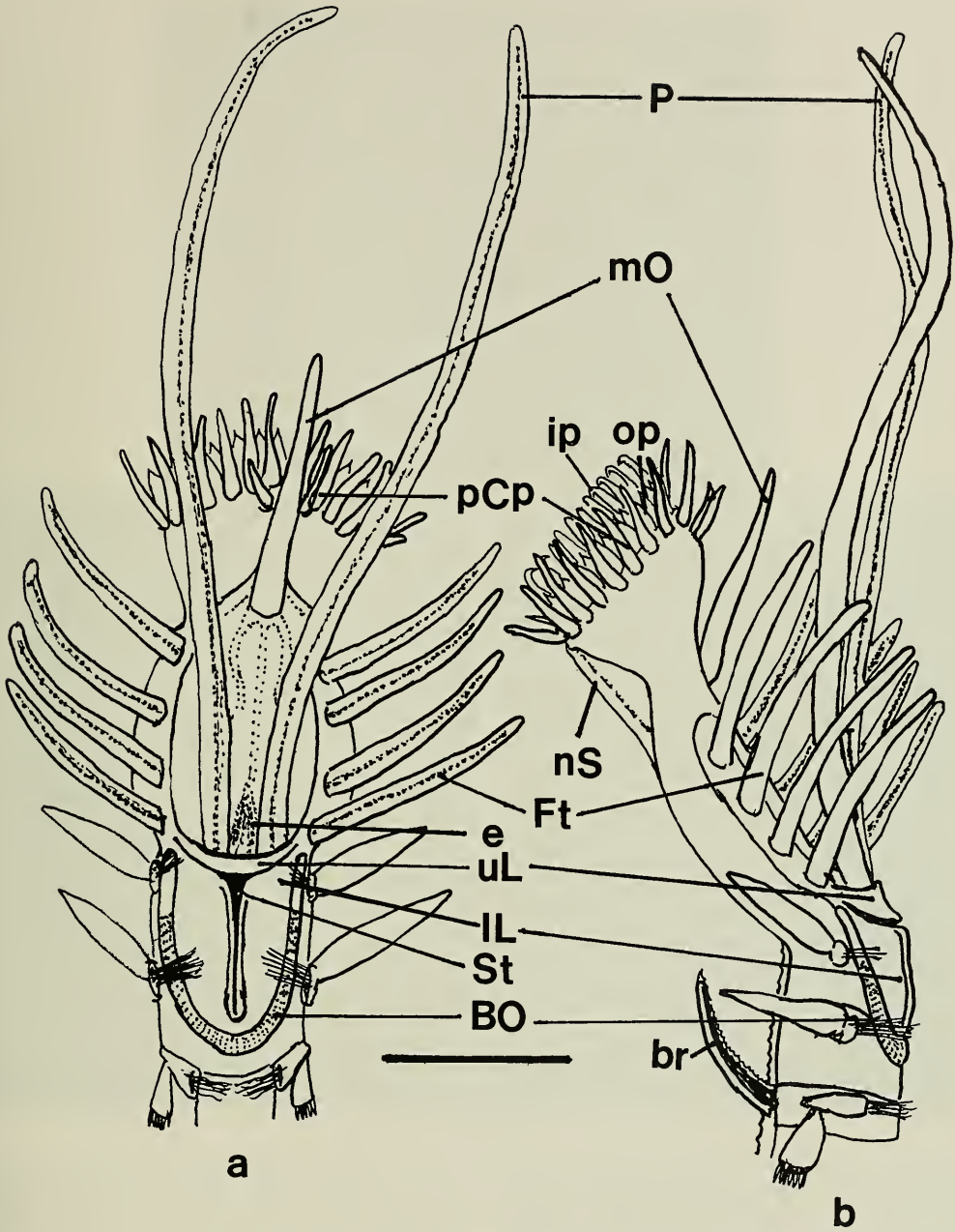


Fig. 2. Conceptual drawing of *Bathysabellaria spinifera* in feeding position with anterior appendages extended. (a) Ventral view. (b) Right-lateral view. Symbols as in Fig. 1. Scale bar = 1.5 mm.

weakly bent nuchal spines on dorsal side of opercular stalk (Figs. 1b; 2b; 6A).

Four (in some specimens three) filiform, ciliated, feeding tentacles ("oral tentacles" of Dales, 1952:436; "oral filaments" of Or-

rhage, 1973, fig. 1c) in ventral longitudinal series on both sides of prostomium. The series of feeding tentacles arises from the line of fusion of the paleal stalks and the prostomium (Figs. 1a, b; 2a, b; 6B); beginning

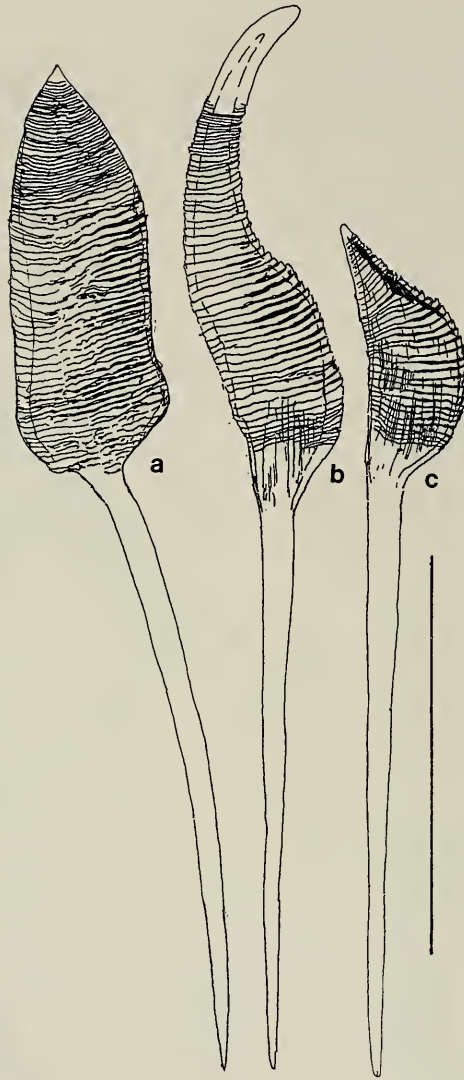


Fig. 3. *Bathysabellaria spinifera*, paratype. (a) View of inner surface of outer palea; (b) inner palea; long form; (c) inner palea; short form. Scale bar = 750 μm .

anterior to the antero-lateral ends of the upper lip (but not *from* it, as stated by Orrhage 1978:343) and continue to the base of the crown (Figs. 1a; 5B). Tentacles with narrow, longitudinal, ventral, grooves lined with small cilia and transverse bands of cilia tufts (described as "membranelles" from SEM images by Thoms 1988:24) with larger cilia. Large, paired, palpi ("prostomial tentacles" of Dales 1952:450; "preoral prehensile tentacles" of Kirtley 1994:5);

with conspicuous ciliated longitudinal grooves; arising from both sides of the midline of the posterior margin of prostomium, anterior to the border of the upper lip (see *Remarks*, below).

First thoracic segment includes stoma with transverse upper lip and lower lip (in fixed specimens) with medial longitudinal fissure and bulbous, transverse, basal fold or labial pouch (Figs. 1a; 6B). Glandular, horseshoe-shaped building organ surround-

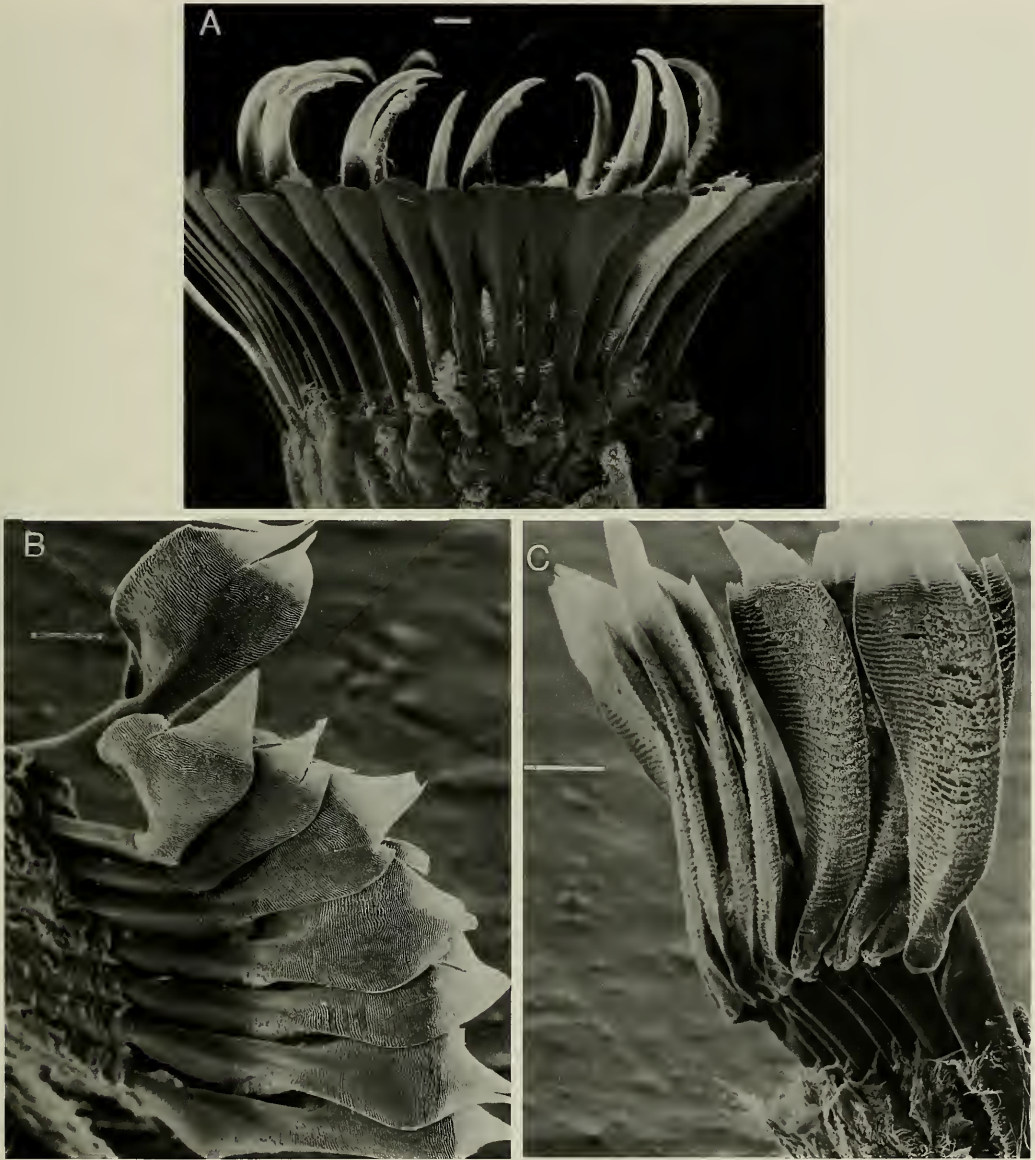


Fig. 4. *Bathysabellaria spinifera*, paratype. (A) SEM photo of crown. (B) Inner surfaces of outer paleae. Scale bars = (A) = 10 μm ; (B) = 100 μm .

ing posterior and lateral margins of stoma. Anterior ends of building organ terminate as extensible conical lobes with fascicles of fine capillary neurosetae arising from base of small, fleshy, triangular, lobate cirri (Figs. 6B, C: C₁).

Second thoracic segment with bundles of large and small capillary neurosetae with

pectinate thecae (Figs. 6A, C: C₂), arising from base of inferior conical cirri; with small superior asetigerous cirri; without paired dorsal branchiae.

Parathoracic segments four. Notopodial fascicles ("sheaves" of Dales 1952:357) muscular; with transverse series of from four to six pairs of capillary and lanceolate

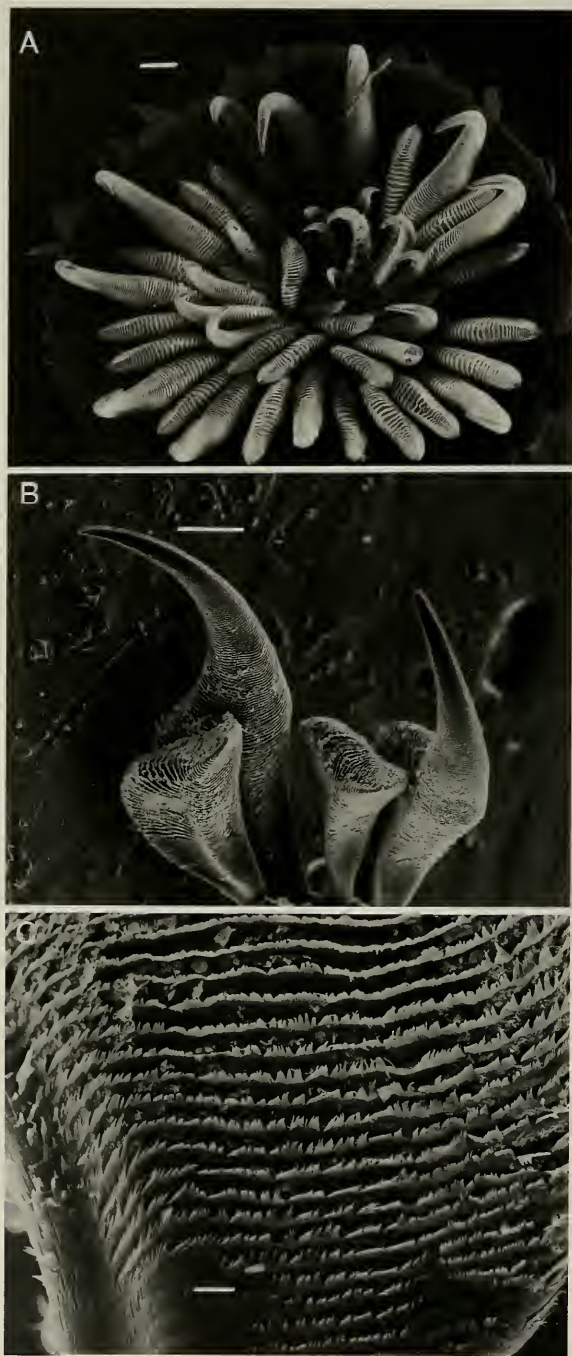


Fig. 5. *Bathysabellaria spinifera*, paratype. (A) Anterior surface of crown. (B) Long and short forms of inner paleae. (C) High magnification SEM photo of inner surface of outer palea showing fringes on thecal bands. Scale bars = 100 μm .

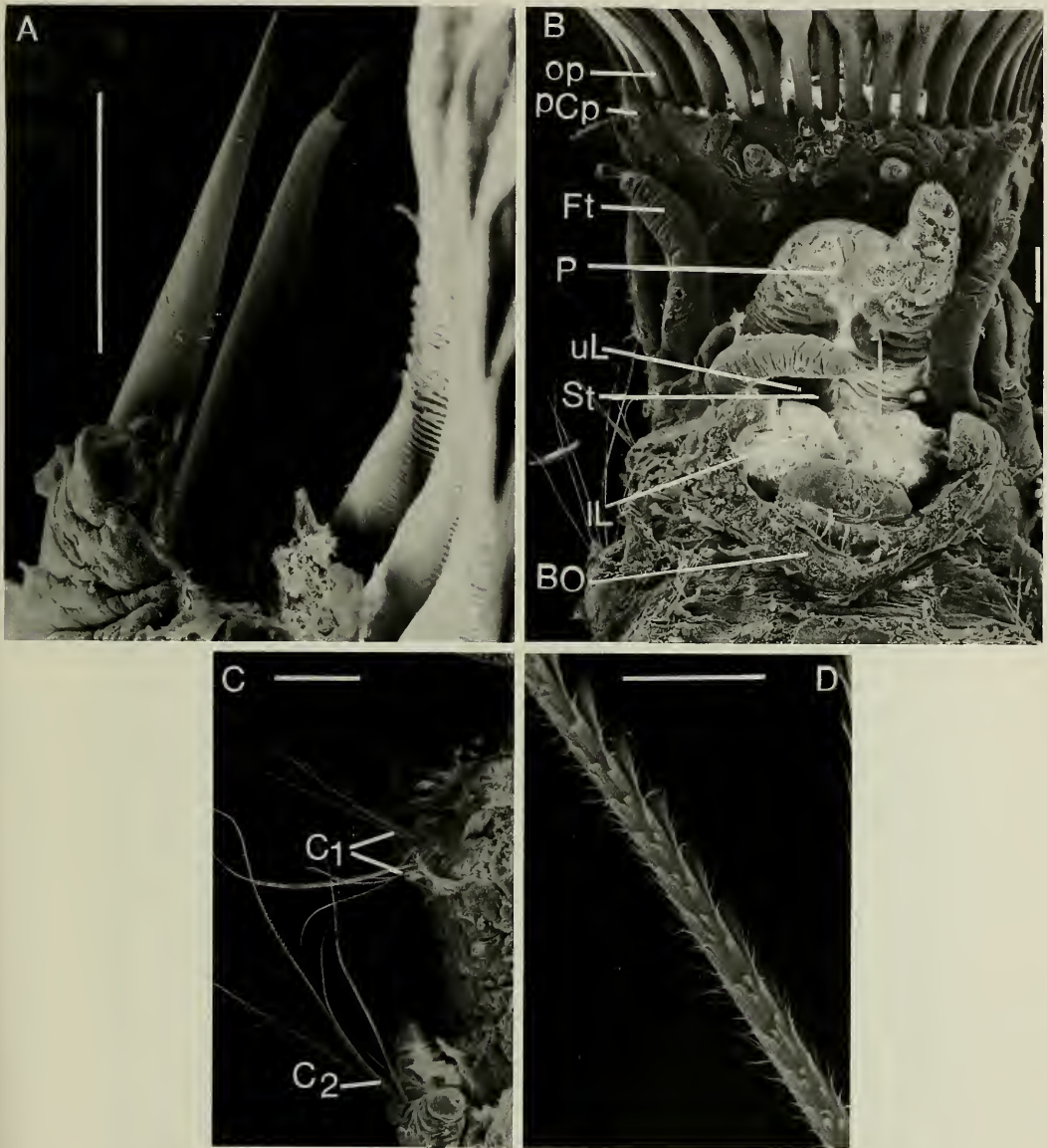


Fig. 6. *Bathysabellaria spinifera*, paratype. (A) tips of nuchal spines. (B) Ventral view of anterior end. op, outer paleae; pCp, pericoronal papulae; Ft, feeding tentacle; P, palpi; uL, upper lip; S, stoma; lL, lower lip; BO, building organ. (C₁), setae of first thoracic segment; (C₂), setae of second thoracic segment. (D) large and small forms of capillary setae from second thoracic segment, (C₂), adjacent photo. Scale bars (A, B, C) = 100 μ m; (D) = 10 μ m.

setae (Figs. 1a, b; 7A, B). Capillary setae thin, with finely hirsute distal fringes; lanceolate setae with coarsely frayed distal ends (Fig. 7C). Neurosetae capilliform, of two kinds: small form with hirsute distal fringes, large form with asymmetrically

whorled thecae with delicately pectinate distal fringes; thecae of smaller form with smooth margins (not shown); parathoracic notopodia successively larger and longer toward posterior (Figs. 1a, b; 2a, b; 7A). Paired dorsal branchiae on each parathora-

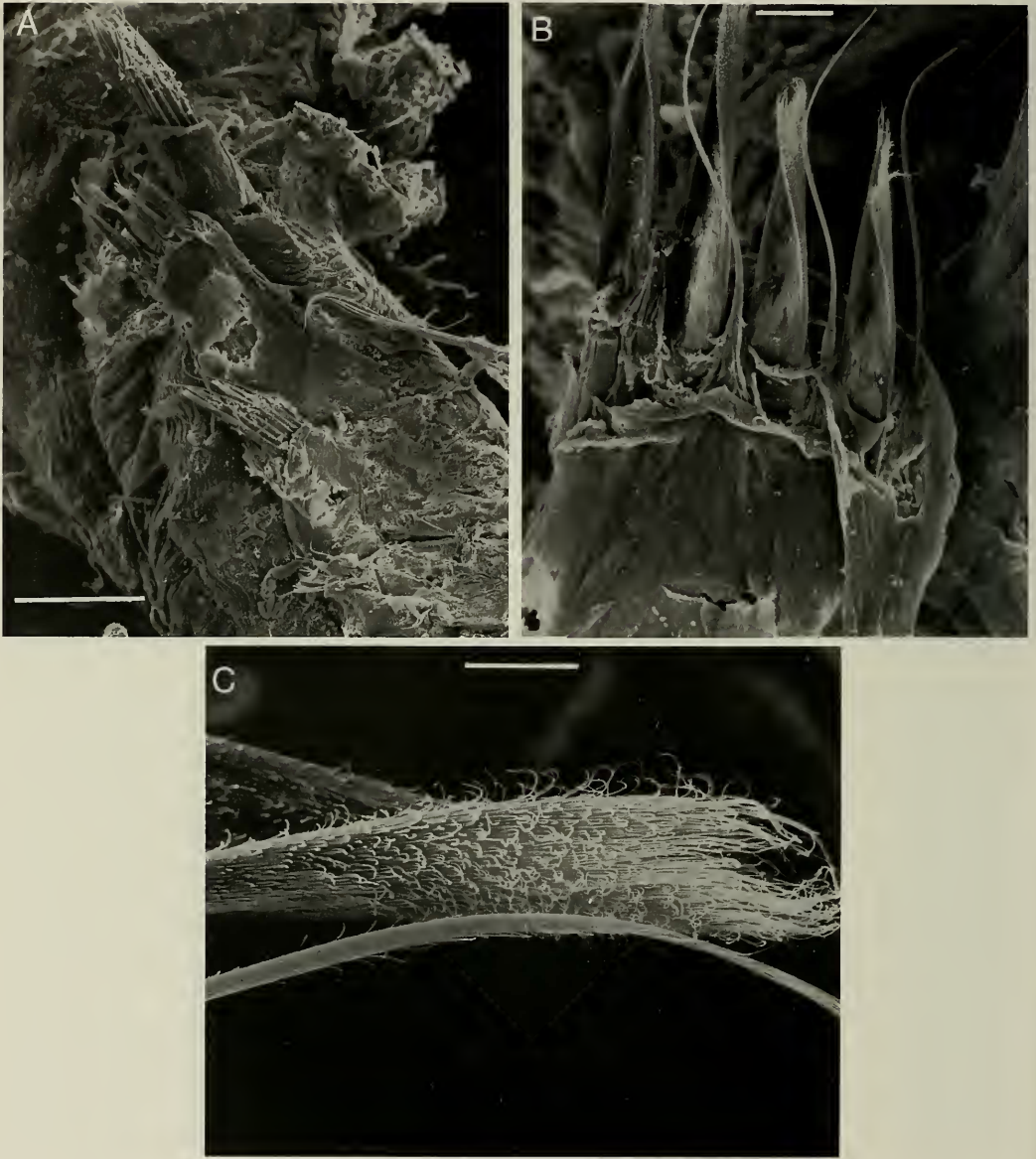


Fig. 7. *Bathysabellaria spinifera*, paratype. (A) left-lateral view of parathoracic notopodia. (B) magnified view of notopodia of third parathoracic segment. (C) tips of lanceolate and capillary forms of neurosetae from third parathoracic segment. Scale bars (A, B) = 100 μ m; C = 10 μ m.

cic segment. Branchiae also present on first few abdominal segments; reduced in size or absent on posterior segments. Abdominal region consists of 16 setigers. Neuropodial bundles with two kinds of setae: thin form with finely hirsute distal thecal margins; thick form with spiral whorls of thecae with

serrate distal margins (Fig. 8A). Abdominal notopodia with broad uncinigerous tori; posterior margin of tori with transverse series of many small uncini; each uncinus with paired marginal rows of eight or nine strongly bent teeth; points directed anteriorly (Fig. 8B). Cauda smooth, reflected on

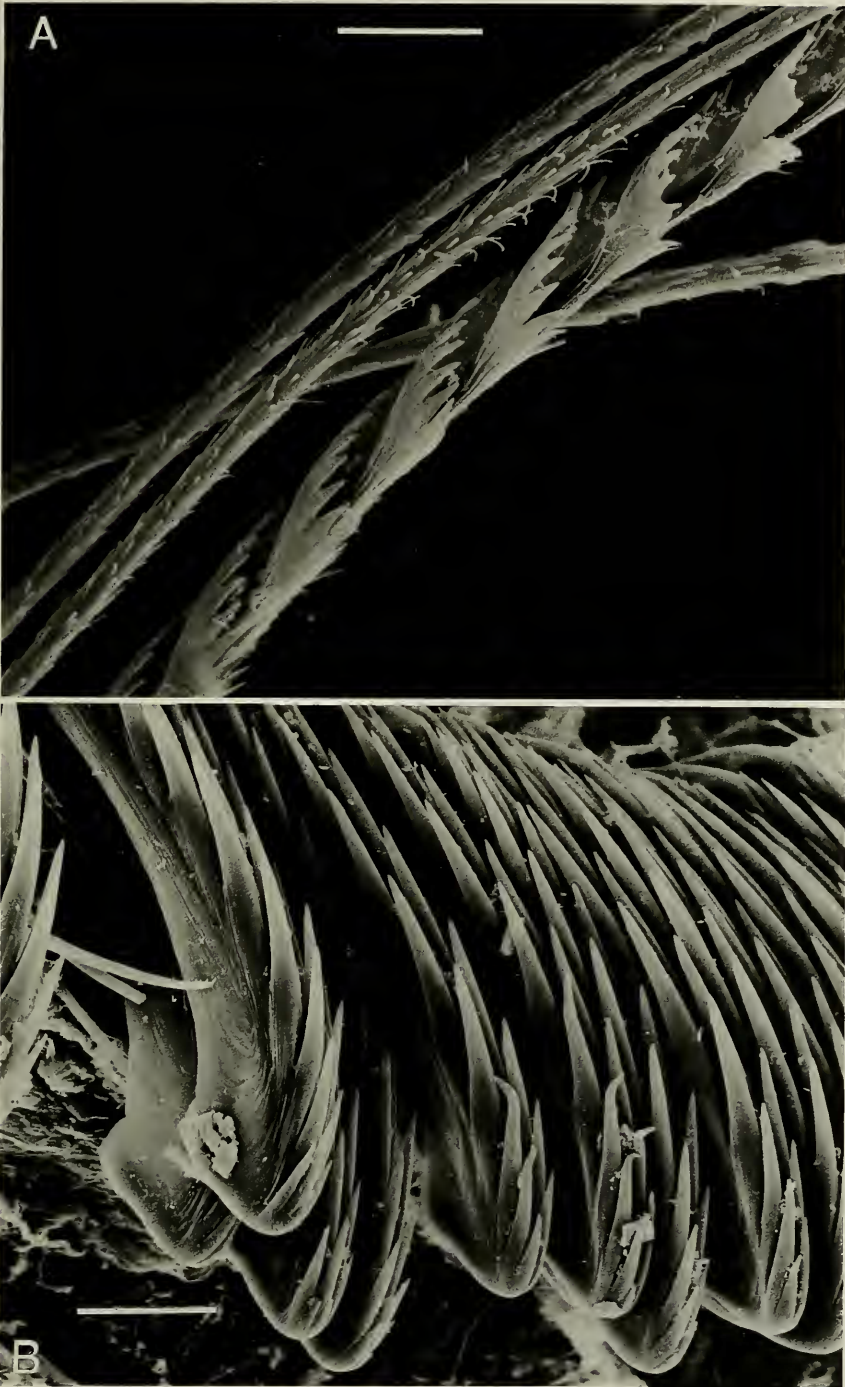


Fig. 8. *Bathysabellaria spinifera*, paratype. (A) Large and small forms of neurosetae from first abdominal segment. (B) notopodial uncini from first abdominal segment. Scale bars = 10 μ m.

Table 1.—Primary differentiating characters of the genera in the subfamily Lygdaminae Kirtley, 1994. (1 = present; 0 = absent).

Genus	Feeding tentacles compound (branched)	Feeding tentacles simple (un-branched)	Opercular stalk bilobate	Opercular crown entire	Crown with mid-ventral declivity	Nuchal chaetae with hooks	Nuchal chaetae without hooks	Median organ dorsal	Median organ ventral	Median organ indistinct
<i>Bathysabellaria</i>	0	1	0	1	0	0	1	0	1	0
<i>Gesaia</i>	0	1	1	0	0	1	0	1	0	0
<i>Lygdamis</i>	1	0	1	0	0	1	0	1	0	0
<i>Mariansabellaria</i>	0	1	1	0	0	0	1	0	0	1
<i>Phalacrostemma</i>	0	1	1	0	0	1	0	1	0	0
<i>Tetreres</i>	0	1	0	0	1	1	0	1	0	0

ventrum. Only proximal part of the cauda present; distal portion macerated and missing.

Specimens all removed and separated from tubes at sorting center. Fragments of tube walls found adhering to bodies of some individuals consist mostly of foraminifera and small bioclasts, cemented to each other with mucous cement produced by the worms.

Etymology.—*spinifera* = Latin (*spina/fero*) = thorn-bearing; referring to the shape of the long form of inner opercular paleae that distinguishes this species from the type-species.

Remarks.—Relatively few species of Sabellariidae have been reported from the southwestern Pacific Ocean area. Caullery (1913:200; 1994:54–66) examined the Sabellariidae collected during the *Siboga* Expedition to the vicinity of what is now called Indonesia. He listed two species of *Idanthysus* Kinberg, 1867; a new species of *Phalacrostemma* Marenzeller, 1895; two species of *Lygdamis* Kinberg, 1867; and a new species of *Tetreres* Caullery, 1913; (see synonymy in Kirtley 1994:188). Hoagland (1920:627) described a species of *Lygdamis*, as *Tetreres treadwelli* from a depth of 18.3 m from the *Albatross* station D5109; between Cebu and Leyte Islands in the Philippines. Gibbs (1971:192) collected *Lygdamis gibbsi* Kirtley, 1994:127, from the near shore benthos in the Solomon Islands. Species of *Neosabellaria* Kirtley, 1994, and a species of *Paraidanthysus* Kir-

tley, 1994, are known from near shore waters of New Zealand. Bailey-Brock (1985:202, fig. 5a–e) described an intertidal sabellariid (as *Sabellaria* sp.) from Suva Harbor, Fiji Islands.

The presence of a completely fused opercular lobes and crown, the morphology of the paleae, and the presence of a ventral median organ are the principal diagnostic features that distinguish *Bathysabellaria* from all other genera of Sabellariidae with four parathoracic segments (subfamily Lygdaminae, Kirtley 1994:14). Differentiating morphologic features within the subfamily are summarized in Table 1.

The arrangement of the outer paleae in some species of *Tetreres* Caullery, 1913, and *Bathysabellaria* are similar in that the outer paleae have flattened blades and form nearly complete circles around the anterior periphery of the crown. In *Bathysabellaria* the paleal lobes and crown are completely fused but in *Tetreres*, the opercular lobes are completely fused except for a cleft (invagination) at the ventral midline. The inner paleae and nuchal chaetae in the two genera are remarkably different (Kirtley 1994:15, pl. 1). In species of *Bathysabellaria* the nuchal spines are elongate and fusiform and, except for their exposed distal tips, are embedded in the muscular tissue of the dorsum of the stalk. In *Tetreres* the nuchal chaetae are large and prominently visible as elongate, wide bosses conforming to the shape of the thick shafts beneath the epidermis and muscular tissue of both sides for most

of the length of the dorsum of the stalk (Kirtley 1994, pl. 1, and fig. 12.10.1a–e). The hooks have large, rounded shafts and geniculate, outward-bent distal ends with stout, inward curving hooked tips. In species of *Mariansabellaria* Kirtley, 1994, the paleae are arranged in incomplete semicircles on the surface of bilobate crowns and the nuchal spines are flattened (ensiform) blades (Kirtley 1994:136, and fig. 8.2.1d).

Similarly fused opercular lobes, flattened, discoidal crowns, and completely encircling paleae are seen in some sabellariid genera having three parathoracic segments (subfamily Sabellariinae Kirtley, 1994), *Neosabellaria* Kirtley, 1994, *Phragmatopoma* Mörch, 1863, and *Gunnarea* Johanson, 1927. In the genus *Gunnarea*, when the animals are withdrawn into their tubes, the row of outer paleae appear as a complete circle. When the animals extend their anterior ends from their tubes and assume the feeding position the crown is discoidal except for a shallow, wide, depression that interrupts the continuity of the circle of paleae at the antero-ventral midline (Day 1967:668; 673; and fig. 33.1i; Kirtley 1994: 15, plate 1 and fig. 3.1.2d, e). A conspicuous median organ is not present in any species of the above listed three genera. A median organ is present in species of the genera *Sabellaria*, *Paridanthyrus*, and *Idanthyrus*. Most species in Lygdaminae have a conspicuous median organ, except those in the genus *Mariansabellaria*. In *Tettreres* there is a small, conical median organ at the dorsal midline of the opercular stalk (Kirtley 1994, fig. 12.10.1c).

Figures 1a, b, are diagrams of the ventral and dorsal sides of the anterior end of a paratype of *B. spinifera*; as it appears in a fixed and preserved condition. These figures approximate the shape of the animal in the position assumed when withdrawn into its tube; while still living. Figures 2a, b, are conceptual diagrams depicting a possible posture that the animals might assume in life; while feeding and collecting particles for tube construction. The diagrams portray

the relationship of the prostomium, with its eyespots and median organ, to the feeding tentacles, palpi, paleal stalks and crown. Although the species described in this paper has not been actually observed while still alive, it is nevertheless instructive to visualize the possible posture and function of the anterior appendages in assessing and comparing the anatomy and homology of these organs in other sabellariid taxa. The dorsad arching of the anterior end and the orientation and extension of the appendages is characteristic of the posture seen in observations and photographs of other sabellariids with homologous appendages while living (e.g., Wilson 1969:323: *Sabellaria alveolata*; Fitzhugh, 1991:47, *Idanthyrus* sp.; and personal observation by (DWK): *Phragmatopoma* spp. and *Sabellaria* spp.). The lengths and diameters of the extended appendages portrayed in the drawing are arbitrary, but are consistent with configuration of similar appendages observed in living forms. It is noted that, while in the feeding position, the prostomium (as defined below), stoma, and tentacles are directed anteriorly (upward), and the crown is held backward at up to 90° (or greater) angle to the longitudinal axis of the worm. As seen in this diagram the “operculum” also functions as a type of protective dorsal “shield” and the sensory cilia on the pericoronal papillae can control the flow of water around the periphery of the crown and provide sensory information from the dorsal and lateral regions of the anterior end.

The pair of pericoronal papillae on both sides of the ventral midline (Fig. 6B) appear to be anatomically and functionally different from the rest of the series. This possibility is suggested by their particularly shrunken and wrinkled appearance, as compared to the shape and size of other papillae (Figs. 1a; 6B).

The lateral and dorsal portion of the prostomium (“cephalon” of Binard & Jeener 1928:208); is obscured by overgrowth of the opercular stalks and crown which develop from the protoparapodia of first setig-

erous segment. The ontogenic development of the stalks and crown has been fairly well documented in several species of Sabellariidae (below). The following abbreviated interpretation of this process differs in certain details from previous explanations presented by Johansson (1927:25–39) and Hartman (1944:324–325) and is more consistent with the anatomical descriptions of von Drasche (1885:5) and Meyer (1887, 1888).

The protoparapodia (the “great chaeta sacs” of Wilson 1929:229) of sabellariid larvae first develop as a doublet of chaetoblastic organs (von Drasche 1885: pl. 2; figs. 3–5), which develop high in the episphere and protrude at the surface on both lateral sides of the hyposphere, at short time (as soon as 10 hours) after the trochophore stage is reached (Quatrefages 1848:190, pl. 4, figs. 7–9; Wilson 1929: 225, pl. 1, figs. 3–7; Cazaux 1964, pl. 1, 4–6; Eckelbarger 1976:123, fig. 1B–D). The doublets produce 2 kinds of primary chaetae: one form from the inner lobe of the sac and a different form from the outer lobe of the sac. In early growth stages the chaetae are quite similar but vary distinctively as the paleae are subsequently produced in several, successive, intermediate forms before the adult stage is reached (Wilson 1929:240, pl. 9, A1–10; B11–18; Eckelbarger 1976:124, fig. 9c–j; Eckelbarger & Chia 1976:2084, figs. 12–15). Near the time of settlement the innermost series of paleae begins to show the general form of the outer paleae of the adults; and the outermost series of paleae begins to resemble the inner paleae in adults. When the chaeta sacs are rotated anteriorly (and occipitally) during settlement metamorphosis the paleae that were in the innermost sac then become the outer paleae and the outermost series of chaetae become the inner series on the crown. The chaeta sacs grow larger and develop into muscular “stalks” which overgrow the lateral and dorsal margins of the peristomial region of the episphere and either be-

come fused together along the anterior midline in *Bathysabellaria* and some other genera; or remain as separate lobes. In both cases a kind of cephalic cage (sensu Fauchald 1977:156) is formed.

Fauchald (1977:118) states that the “Prostomium [is] a narrow ridge fused laterally to the first setiger” in the Sabellariidae. This definition is appropriate in genera with bilobed opercular stalks but where the lobes are completely fused, as in the case of *Bathysabellaria*, *Neosabellaria*, *Phragmatopoma*, and *Gunnarea*, or almost completely fused, as in *Tetreres*, the lateral boundaries of the surface expression of the prostomium on the ventrum are less restricted and a relatively wide area on both sides of the ventral midline is included. The external expression of the prostomium in genera with completely fused stalks, including *Tetreres*, is a roughly triangular area on the anterior ventrum between fused paleal stalks, anterior to the upper (transverse) lip of stoma and bounded on both sides by the longitudinal series of feeding tentacles. The anterior limit of the external portion of the prostomium appears to be the posterior midline of the fused paleal lobes and pericoronal papillae (as noted above). In *Bathysabellaria* spp. the prostomium includes the ventral median organ (Figs. 1a; 2a, b). In Fig. 6B the median organ is not visible because it is behind the two palpi. The area has been designated the “buccal cavity” by some previous authors. It is properly the surface expression of the prostomium, and not an anterior extension of the peristomium (as inferred by the statements of Orrhage, 1978.)

Species in genera in the subfamily Sabellariinae Kirtley, 1994, with completely fused anterior ends, the presence of an organ homologous with the median organ has not previously been recognized.

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